Comments on the
Ecological Risk Assessment for
General Electric (GE)/Housatonic River Site
Rest of River, volumes I-II
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Introduction and disclaimer

This review of the Ecological Risk Assessment of the Housatonic River/GE Site was conducted under a grant from the Environmental Protection Agency to the Housatonic River Initiative. The materials and conclusions presented here are those of the authors and do not represent the position of the EPA, ACOE or any other federal or state agency.

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The context of this report is to provide feedback on the Ecological Risk Assessment to the EPA and to inform the citizens (through Housatonic River Initiative and Housatonic Environmental Action League) of the strengths and weaknesses of the Ecological RA. This feedback and evaluation is also intended for the scientific peer review panel that will evaluate this Ecological RA in 2003. It is the intent of the reviewers and authors of this report to improve the Ecological RA and eventually result in a more protective site cleanup.

The purpose of these comments is to evaluate if the Ecological Risk Assessment adequately protects the ecological health of the environment of western Massachusetts and Connecticut from the toxic chemicals released from the GE facility in Pittsfield, MA. This review examines the scientific information and methods used, the underlying information, both quantitative and qualitative, the assumptions, logic and reasoning and other significant aspects of the Ecological RA.

This report includes:

- Overall Evaluation
- Risk Assessment Limitations

- General Comments
- Specific Topics
  - Population protection v effects on individual animals
  - Connecticut flood plain
- Volume Specific Comments: I, II
- References
- Appendices: Literature Searches; news story by Tuz; Floodplain articles; excel data on Sediment data from CT

Overall Evaluation

The Ecological Risk Assessment (EcoRA) uses standard EPA practices and guidelines for the most part in assessing the environmental risks from chemical contaminants in the Housatonic River as a consequence of activities at the GE plant in Pittsfield MA. The EcoRA focuses on PCB's and the dioxin-like compounds (noted as TEQ's), with some consideration of other organic chemicals and metals.

This EcoRA uses the data and other information gained from a comprehensive ecological survey conducted over several years in the Housatonic River region. This ecological survey was thorough and well designed, providing information on the plant and animals populations of the area. As such, EPA had an extensive database to use in conducting the ecological risk assessment.

The EcoRA uses some newer analytical methods to assess the results of the risk assessment. These tools are statistical analyses of the risks predicted in the assessment, specifically probability bounds and Monte Carlo analyses. In using these, the EcoRA attempts to depict and understand the uncertainty in the predictions. The results of these two analyses present the range and variation in the risk estimates. These add a great deal to the analyses by showing how the results affect the evaluation of risk to populations.

The conclusions that the wildlife are at risk and will continue to be at risk from the PCB contamination of the Housatonic River is supported by the data and we agree entirely with that assessment. We do not agree that the risks are as low in the Connecticut part of the River, and think that that data do not support a quantitative analysis of risks in the lowest part of the river. Furthermore, we maintain that the risks to fish are high in the upper part of the river, on the basis of the literature, the modeling and the presence of abnormal fish in the upper reaches.

The EcoRA departs from any EPA practice of conservative risk assessment by using a number of decisions that result in assignment of lower risks at higher levels of contamination. The EcoRA uses mean (geometric) or median NOAEL's (or NOEL and LOEL) or even LOAEL's to set toxicity benchmarks, rather than the lowest values. The lowest toxicity values from the literature are not used

when there is a need to rely on literature values for such. The sediment concentrations for benthic invertebrate were averaged over larger areas. Estimates or measurements of toxicity were based on periods shorter than many months or even the lifetime of the organism. The estimates of risk depend in all cases on some knowledge of how the animals metabolize contaminants and the baseline metabolic rate (free metabolic rate) yet the text acknowledges that these values were estimated in most, if not all cases.

The EcoRa did not, as is the current state of practice at EPA, assess the risks from multiple chemicals, and in fact discounted the pesticide levels from this evaluation. The lack of consideration of combined effects of the PCB's, PAH's, pesticides and metals is another non-conservative feature. An additional level of protection needs to be added to compensate for this inability or weakness in the EcoRA.

Risk Assessment Limitations:

This RA cannot overcome most if not all of the major limitations of RA that are an inherent part of the process and practice as it is conducted in EPA. These limitations include the following:

- Reliance on the known factors in toxicology, with no ability to act on the unknown chemicals, processes or concepts- such as low dose effects, non-monotonic dose-response functions or novel outcomes. The toxicology of lead is now proving challenging because recent findings indicate there may be no threshold for effects, a point that is acknowledged in the CDC statement on lead poisoning.

- Traditional toxicology has been unable to account for completely unknown and unpredicted events and processes. The endocrine disruption issue is the most well known example of this problem (Colborn et al., 1993). Traditional toxicology testing uses high doses and examines known effects that are not subtle, long term or trans-generational and can be observed in typical rat bioassays with known endpoints. Endocrine disruption was overlooked for decades in no small part owing to the non-traditional nature of the mechanisms and outcomes. But now that the phenomenon is recognized, numerous other aspects of endocrine disruption are being described in the literature (e.g., deFur et al. 1999).

- Little ability to predict risks from chemicals for which there are no toxicological data or effects that are not well studied in the toxicological literature. EPA and other regulatory agency risk assessments often fail to include chemicals in the risk analysis if there are no entries in the official EPA database. For example, EPA has few data on impacts of dioxin-like chemicals or PCB's on specific benthic species.

- Has yet to develop quantitative methods for dealing with mixtures that do not act through a common mechanism of action.

- Assumes there is sufficient knowledge and understanding to accurately (or within some tolerable range) predict consequences of all contaminant conditions, in the present case, long-term exposures to low levels of PCB's and TEQ's.

- Risk assessments use averages or some other measure of central tendency or estimate of the population. Even in the most conservative cases, risk assessments do not use the most highly exposed animals in a population, but give a population estimate over some geographic area. This procedure leaves out the most highly exposed animals and more sensitive individuals that will react adversely to low levels of chemicals.

- Ecological Risk Assessments deal with populations of individual species and, in the case of chemicals, individual chemicals. At best, ecological risk assessments can consider some combinations, but not many. There are no techniques for assessing the effects on properties of ecosystems or habitats that cannot be ascribed to individual species. Some of these ecosystem properties include energy flow, niche availability and long-term diversity. Nor can the EcoRA deal effectively with the full complement of mixtures of chemicals and other stressors.

These limitations of the RA are meant to strengthen the ability of assessors to evaluate the results and decision-makers to make protective decisions. These issues are raised not to lessen the ability to use the tool of risk assessment in analyzing the data that are available with the most rigorous methodology. These limitations are noted for the review in order to indicate that the current practices of risk assessment will not be able to address all aspects of the threats from chemical contaminants. Risk assessment is but one tool used to evaluate the contamination at the GE/Housatonic site. Other tools must be used to complement the traditional risk assessment. Other such tools include Monte Carlo and probability bounds analysis to evaluate uncertainties; application of the precautionary principle (see Raffensperger and Tickner, 2001) where the data are sparse or absent; toxicology testing to gain empirical information on specific conditions. Many of these tools were used in conjunction with the EcoRA and they must be applied rigorously throughout.

In those areas where the risk assessment is limited by few data and inapplicable methods, decisions should be based on a protective and conservative approach to protect ecological resources.

Major Issues

- EPA must protect the individual animals within a population, as well as insuring that the population is viable and reproducing. Large populations of unhealthy fish do not constitute an acceptable reason to suspend cleanup activities or fail to protect natural resources. Diseased organisms, regardless of population size, should not be considered "low risk" or even "medium risk".

- There is a lack of floodplain data for the river once it flows into Connecticut. Both maps and comments throughout the EcoRA attest to the existence of floodplains in Connecticut, yet there is a lack of data from sediments, water, aquatic and benthic organisms in the Connecticut portion of the river.

- There is missing or inadequate analysis on several species that were observed in the Ecological Risk Assessment performed by Woodlot Alternatives, Inc., for the USEPA (Nov. 2002). These species include: black bears, bobcats, coyotes, fishers, and owls. The large populations of these animals, coupled with their dependence upon the Housatonic River system in the vicinity of the contamination, render them appropriate candidates for further study. Also, there is a complete lack of data for domestic animals, both in Massachusetts and Connecticut.

- It is still not entirely clear why the NOAEL's were selected for the species assessed here. The selection of thresholds/AL's based on other studies does not always give the lowest NOAEL values, and hence do not provide the greatest protection. The EcoRA should offer some estimate of how the output would be affected if the NOAEL's were actually lower than indicated here.

- Free metabolic rates (FMR) are not known or not used for most of the individual species in the Eco RA. Instead, the assessment relies on literature investigations that combine the existing values and construct a mathematical predictive equation for estimating free metabolic rates. This method is well used in physiology for estimating and for determining trends and patterns. This use is regulatory and has a greater need for accuracy and protection of the species under study. In addition, it is not clear that mink and otter would fall on the same curve as other animals, given their greater metabolic scope and need to thermo generate quickly and on a regular basis. Recommend using a modification of the values from the estimating curve based on a greater FMR.

- There are several problems that this EcoRa presents that are inherent to all risk assessments. These are listed in a separate section on the topic above. Two such issues are worth repeating and noting here for particular attention. First, neither human health nor ecological risk assessments deal with the health of domestic and agricultural animals.

The closest that any risk assessment comes to addressing either group is to consider the exposure of humans to contaminated agricultural products – milk, meat and vegetables. There is no consideration here, or in almost any risk assessments conducted in the US of the health of domestic and agricultural animals. Both can be assessed and a supplemental effort should be undertaken to remedy this omission.

- The other omission from risk assessments is the cultural use and significance of the place. Religious sites, cultural sites, archeological sites are not part of either human health or ecological health, they are cultural health and socially significant. The Housatonic River valley has been home to humans for tens of thousands of years. Contaminating important regions and sites is an important factor that must be considered in the site assessment.

Protecting the individuals and the population

The Eco RA reaches the conclusion that there is low to medium risk to the fish in the Housatonic River, based on laboratory studies, literature reviews, and the reports of fish populations in the Housatonic River, largely from the field surveys conducted by GE or contractors. These later results seem to weigh sufficiently in the EcoRA that the normally toxic levels of PCB's in sediments (for reviews (see Geisy, 1996; Rose et al., 1999; Rice, O'Keefe and Kubiak, 2003) do not convince EPA that the fish are at high risk, despite the abundant data that fish are impacted by PCB's in the Housatonic R.

A reproducing population is not healthy if the individual members of the population are unhealthy, despite their reproductive capability. According to the Guidelines for Ecological Risk Assessment, EPA protects at the level of the population (EPA, 1998), not at the level of the individual. Carried to the extreme, this position will allow a population of animals to suffer any range of ill effects so long as enough animals reproduce and the next generations continue as before, no matter the health of the individuals or the population age structure.

This problem of protecting the population and allowing the individuals within the population to remain or become unhealthy, poorly functioning, etc., is unacceptable. This issue is not new and is described in some detail by Van Veld and Nacci (2003) for several sites. One of the most well known sites that has this same problem is the Elizabeth River in Virginia that is contaminated with PAH's. Mummichog populations in the Elizabeth River are severely affected by the PAH contamination – all the fish in the population develop liver cancer and die, but not before reproducing. The result is a sustaining population of sick, cancerous fish. This outcome is **not** the sign of a healthy population or healthy ecosystem.

Nor is the Elizabeth River in Virginia the only case of such responses of individuals to persistent contamination by highly toxic contaminants, PCB's especially. The literature contains documentation of the responses of other species to chronic PCB exposure, with metabolic effects on liver function especially. Garman et al. (1998) found that 40% of the catfish in the James River, Virginia had undeveloped sexual organs, though seemingly male, and contained PCB's, TBT, DDT and Hg.

Connecticut Watershed information: floodplains and sediment samples-Floodplain Information

There has been insufficient testing on sediments and animals outside the immediate area of the Housatonic River bank in Connecticut due to the belief of the writers of this report is that there is considered to be no extensive floodplain in Connecticut along the Housatonic River. Searches on the issue of floodplains in the Housatonic watershed in CT revealed a variety of information on official flood warnings, reports of official proceedings and news stories of floods. Furthermore, the CT official web site (http://www.dep.state.ct.us/wtr/flood/) lists the Housatonic valley as a flood prone area and a large percentage of the area as a flood plain. The most recent rain events (September 24, 2003) produced flooding in the area, indicating that flooding is a serious issue in the area and needs to be addressed in evaluating the distribution of PCB contamination (see story by Tuz, Sept 24. 2003, attached).

The table below shows some flood warnings and flooding that have occurred in the last 10 years:

Connecticut Floodplain Data

Location	Year	Comments
Hartford & Oxford	1993	Flooding (flood gates opened wider at Shepaug Dam and the Stevenson Dam) at least 6 inches over flood stage.
New Milford & Hartford	1996	Flooding (close Route 7 in New Milford)
North Canaan, Ledyard, Westbrook, Middlefield, Norwich	1996	Flooding (rain and ice melting) (flooded basements of homes)
Litchfield County	2000	Flood warnings
Stratford	02/2001	Flooding (businesses flooded)
Bulls Bridge to Derby	03/2003	Flood warnings
Falls Village	03/2003	Minor Flooding (1.1 feet above flood stage)
Gaylordsville	03/2003	Flooding (1.3 feet above flood stage)
Stevenson Dam	03/2003	Flooding (1.5 feet above flood stage)

Ashley Falls, Mass to Cornwall Bridge, Ct.	04/2003	Flood warnings
Gaylordsville	04/2003	7-8.7 feet above flood stage

This table indicates that there is a flood issue along the banks of the Housatonic River in Connecticut, and these flood prone areas should not be ignored in sediment testing for PCBs. In 2003 alone, there have been at least six different occurrences of possible flooding, which could carry the PCBs into these various areas. The more that flooding occurs in these areas, the more contaminated sediments are carried outside the immediate borders of the River. The flood plain and sediments of Connecticut cannot be ignored in the evaluation of PCB contamination of the Housatonic River.

Sediment samples:

The sediment sampling effort was focused on MA, with only a modest amount of sampling in CT. The following table summarizes the data from the records on the sediment sample results used in the risk assessment. It is clear that the majority of the data are from historical samples, obtained by GE, and not an independent contractor, and not by EPA or EPA contractor. The samples provide very little data on the greatest part of the river, a few samples from behind the dams and virtually no information on the backwaters and small tributaries.

Summary of total PCB in Housatonic River Sediment/Backwater

Reach	Number of Samples
10	80
11	16
12	78
13	41
14	172
15	148
16	17
Total	552

Depth	Number taken at depth in 2001
0-.5	23
0-.25	3
0-.45	1
.5-.75	4
.5-1	6
0-.417	1
0-.834	1
2.5-3	1
2-2.5	1
1-1.5	3
Total	44

Year	Number of Samples
1972	2
1973	3
1974	3
1975	3
1976	3
1977	2
1979	1
1980	146
1986	100
1992	147
1998	78
1999	20
2001	44
Total	552

2 samples taken behind Bull's Bridge Dam
2 samples taken behind Great Falls Dam
3 samples taken behind Blackberry Dam

Specific Comments

Volume 1

2; 2-12; lines 22-24: "Floods also increase river velocities and shear stresses that can cause the river bed to scour."

What about "icing events" (extended periods of <0^{o}C when ice scour causes increased erosion and habitat destruction). This should be included as a physical stressor; it's a much more common event in this area than a hurricane. The scour will increase gouging and physical disturbance of the sediments and contribute to distribution of contamination in the river system. The EPA work pan calls for collecting data on river flow during a 100-year storm event, and without those data, the estimates will be incomplete. In the absence of such empirical data, the ecological risk assessment should project worse case conditions as a multiple of the known extreme conditions for which there are data.

2; 2-13; lines 13-14: Both physical and biological stressors within the PSA are influenced by anthropomorphic changes that have occurred within the watershed….

Fragmentation of the riverine landscape should be mentioned here – the loss of the river continuum blocks the natural movement of energy, nutrients, and organisms. Six dams are mentioned in 2-10, lines 1-2; this should be elaborated upon. These dams collect sediment, as noted in the risk assessment, and these alterations occur throughout the river where roads cross the river, bridges and other shoreline structures exist.

2; 2-22; lines 12-13: The conservative benchmark used for this analysis was a threshold effect concentration (TEC) of 0.0598 mg PCB/kg sediment (MacDonald et al. 2000). –

The document needs to explain why this TEC was chosen, whether it is the most protective, or has the most relevance to the species in the Housatonic River, or some other reason.

2; 2-24; lines 12-15: The analysis of surface water included samples collected between 1996 and 2002. This slightly longer span of time was used because of the more robust data set that was available. A full presentation of the spatial and temporal trends is presented in the MFD (Weston 2003, in preparation) and the RFI report (BBL and QEA 2003).

First, the ecological risk assessment needs to use only documents and reports that are available to others. Citing and relying on a dataset and report that are in preparation and not yet available is not an acceptable option. The data have to be made available to the public and others. The temporal and spatial trends are

important for different reasons in this system and this application. The temporal trends indicate the nature of flux of PCB's that have a low but not zero solubility in water.

2; 2-25; lines 21-23: "Sediment samples collected prior to 1998 detected PCBs as high as 2,270 mg/kg in Reach 5A. PCBs have also been detected as deep as 6 to 8 feet below the riverbed surface throughout Reaches 5 and 6 (BBL and QEA 2003; WESTON 2003, in preparation)." –

The presence of PCB's in deep sediments provides additional evidence that the PCB's have been distributed over many decades. Given the nature of the hydrology of the river, the presence of dams in the lower part of the river, the accumulation of PCB's in all other dammed waters, and the paucity of data in Connecticut, it is imperative to augment the present information with sediment, fish tissue and benthic animal tissue samples to ascertain the extent of contamination in Connecticut.

2; 2-28; lines 9-12: "Little to no floodplain terrain exists within the Connecticut portion of the river; therefore, no samples were collected from those reaches. Mean tPCB concentrations are broadly similar within Reaches 4,5, and 6, averaging slightly more than 15 mg/kg, and then decreasing by an order of magnitude in Reaches 7,8, and 9."

Sampling should take place in the Conn. Portions of the floodplain; see 1,2-8; lines 25-27. The table above shows that flooding in the Connecticut portions of the Housatonic occurs regularly enough that the floodplain needs to be measured, not discounted out of hand.

2; 2-29; lines 29-31: "…because most of the data downstream of Woods Pond, especially in Connecticut, were collected prior to 1996. Figure 2.5-13 presents only the surface water data collected since 1996."

These data showed high enough concentration to warrant additional sampling.

2; 2-43; lines 4-12: "Spatial trends in chlorination level (which may be used as a surrogate for alterations in congener distributions related to chemical properties) were evaluated in sediment and porewater. No trend with distance downstream was observed in porewater. A modest reduction in chlorination level was observed in bulk sediments, however. Typically, the majority of Cl/BP ranged from 6 to 6.5 for samples collected within Reach 5A t of the PSA, whereas downstream samples (Reaches 5B and 5C) usually had 5.5 to 6 Cl/BP. This confirms that changes in the congener distribution with distance from the source are possible, but are limited because of the highly chlorinated nature of PCBs in the source media."

Lines 23-26: “Therefore, it appears that physical transport of PCBs (via bedload and suspended particulate matter at higher flows, and diffuse flux at lower flows) is the dominant fate process, with dechlorination of PCB mixtures a relatively minor process.”

The fact the majority of transport is via distribution of sediments and that these sediments have been accumulating behind dams in CT is the evidence that more sediment data are needed to adequately characterize the extent of contamination in that part of the river.

2; 2-44; lines 18-20: “In the atmosphere, dioxins and furans are typically adsorbed to particulates with the vapor-phase tending to be negligible (Paustenbach et al. 1991). Vapor pressure and ambient temperature are the two environmental factors controlling the phase of congeners in the atmosphere.”

EPA has been conducting work on the volatilization of dioxins, furans and PCB’s, notably from the spreading of sewage sludge in agricultural situations. Results presented by Dave Cleverly at an annual ACS meeting indicate significant volatilization. EPA has also completed a report on POPS, persistent organic pollutants, at a global level, finding that Arctic PCB pollution is caused by volatilization and log range transport (EPA, 2002). There is no evidence that volatilization does ***not*** *occur, and in fact with the evidence used in the EPA POPS report, this risk assessment has to account for this phenomenon and not simply discount it.*

2; 2-45; lines 1-2: “…to a lesser extent by volatilization (Paustenbach et al. 1992). Resuspension of sediment-bound dioxins and furans can increase their transport and availability for uptake by aquatic biota.”

It is not clear that this is the best reference for this issue, but nonetheless, that matter remains that the document supports the conclusion that downstream transport of PCB’s is a major concern.

Lines 15-16: “The estimated half-life for TCDD reactions with hydroxyl radicals is 2 to 8 days, and the estimated photolytic lifetime ranges from 1 to 7 days (ATSDR 1998).”

2; 2-50; lines 15-17: “The Ah receptor is present in all mammalian and bird species that have been tested, as well as in many species of fish. It is unclear whether the Ah receptor is present in amphibians and reptiles.”
Lines 18-20: “A protein similar to the Ah receptor has been identified in terrestrial invertebrates, but there is no evidence to support the existence of an Ah-receptor type protein in aquatic invertebrates (EPA 1993).”

Research by M. Hahn and R. van Beneden indicate that the Ah receptor has at least some evolutionary connection to the invertebrates, and at least mollusks are susceptible to Ah active chemicals.

2; 2-76; "MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology 39:20-31."

3; 3-13; lines 23-25: "On this basis, and considering that some pesticide detections may be attributable to laboratory interference artifacts, the entire suite of organochlorine pesticides was eliminated from further consideration in the invertebrate portion of the ERA."

There are no data presented to indicate that the pesticides are lab artifacts. This point is really not supported by the data.

3; 3-17; Table at bottom of page:

The table indicates that the toxicity tests were run for 21 days. The animals in the river will be exposed to the PCB's and other chemicals for much longer. Some extended exposures of months are needed to fully evaluate the impacts of PCB's.

3; 3-22; lines 2-4: "Sediment tPCB concentrations downstream of the Connecticut border were generally below 1 mg/kg, reflecting the general trend of decreasing concentration with distance downstream."

Where are the data? We had to specifically ask for these data and they are now included in an appendix for these reviewers. The data in Connecticut are spares and weak. These data do ***not*** ***provide*** *sufficient information to conclude that the risks are low in Connecticut.*

3; Table 3.4-1: "Results of Pairwise Statistical Tests Comparing Exposed Stations to Negative Control (T-Ctrl) and Reference (A1, A3) Sediments (Water-Only Exposures Excluded)"

The data are unclear; this makes no sense on it's own and little more with text.

3; 3-52; lines 318-32: "Based on the TIE study, EVS (2003) concluded that non-polar organic compounds (mostly likely PCBs) were responsible for the observed pattern of toxicity responses."

This point is supported by the data presented here and the literature.

3; 3-79; lines 5-20: “The magnitude of risks to benthic invertebrates…”

The concluding paragraph observes that no matter how the data are analyzed, the benthos is at risk from PCB’s. Considering that the assumptions and procedures were not overly conservative, this conclusion is obvious. What is not obvious is how any conclusion can be reached from the information on the lower reaches of the river where the sediment data are sparse and not recent (see above and attached for data provided). The data from the upper part of the river are sufficient to compel investigations of greater detail in the lower part of the river.

4; 4-32; section 4.4.1 Sediment Toxicity
The summary indicates that frog populations are now under stress from PCB exposures in the Housatonic.

4; 4-44; lines 12-13: “The study results indicates that some endpoints demonstrate a very strong toxic response…”

It is clear from the data that the leopard frog populations in the Housatonic area are now under stress from PCB’s and that the downstream extent of this stress has not been identified.

4; 4-51; Fig 4.4-4 and 4.4-5. *These two figures indicate that extent of the upstream contamination effect on frog populations, but do not show the downstream extent or limit, if there is one. The % malformation continues to rise, even as the PCB levels begin to decrease. The point is clear that the frog populations are severely impacted and the full extent of impact has not been delineated.*

4; 4-58; lines 22-27: *This description of the data contains errors about data in figure 4.4-11. It says one thing about the data and the data obviously shows another thing… this is a big error! There was one study with effects at 0.1 mg/kg and two more at levels < 1.0 mg/kg.*

4:4-84: “In summary…” et seq.

The conclusion is supported by the data for the most contaminated areas and the shorter terms and more obvious effects. The EcoRa has not the data to reach conclusions on longer-term exposures (years) over the entire area and for effects manifested in less obvious ways than mortality.

5; 5-1; Highlights:
This is a good summary of the recent literature on the subject.

5; 5-10; lines 6-11: “The vast majority of relevant exposure data were those collected within the PSA. Extrapolations of risk to most downstream areas relied on the development of exposure-response relationships developed from the site-specific studies and the literature. “

By its own admission here, EPA has not the data to conclude anything much about the risks to fish, other wildlife, etc. in the downstream areas of the Housatonic River.

5; 5-25; lines 1-2: “The Highest NOEL observed”

The EcoRA should use the lowest NOAEL observed, not the highest.

5; 5-25; lines 22-23: “The geometric mean of paired LOELs and NOELs...”

This procedure is not the right one- EPA needs to use the NOAEL as a protective benchmark for effects, not the combination of LOEL and NOEL described here.

5; 5-27; lines 4-9: “Phase I Adult Largemouth Bass – Elevated EROD levels in livers; thickened lobule wall in testes; elevated occurrences of macrophage aggregates; reduced growth in females; reduced estrogen levels.”

These results support the conclusions that the fish are severely affected by the PCB levels. Also note that the data here are more detailed and more specific than for some of the other investigations, reflecting the state of the science and the level of attention to this phase of the investigation. Lack of data in the other species or groups is not lack of effects.

5; 5-27; lines 21-26: “Phase I Largemouth Bass Offspring – Effects Observed: Survival – Reduced survival from hatch to swim-up, or reduced survival post swim-up….”

These data support the conclusion that the populations are severely affected by PCB’s.

5; 5-33; lines 22-24: “Several abnormalities exhibited a dose-dependant or threshold response to high doses of Housatonic River extracts or standards, relative to control fish.”

This result being the case, how can the conclusion be reached that the fish are not severely impacted. These results support our contention that fish in the Housatonic are severely impacted by PCB’s, according to the data in this EcoRA.

5; 5-51; lines 1-2: “There is also evidence that these species are self-sustaining….”

What is this evidence of self-sustaining populations? Furthermore, having failed to assess the health or condition of the fish, as per the description of the field survey methods, there are no empirical data on which to base the conclusion that the individual members of the population are unaffected by the PCB contamination. Indeed, the conclusion seems to be based on finding fish of size and presumably age distributions, and total biomass that fall in a set range. No data were obtained or presented on reproductive function, immune system, developmental status or physiological performance. As described above for Fundulus in the Elizabeth River, VA., a population of fish may sustain and still all die of cancer.

5:5-55, lines 13-15: Within the PSA, Table 5.4-1 indicates a moderate to high probability of exceedance…"

Another way to interpret the data are that the probability is high to nearly 100% that some effects will be observed, based on the limited ability of the noted effects thresholds to capture all the responses at the cellular and molecular level. If one chooses the lowest values in Figures 5.4-2 through 6, and then adds another 10-fold level of uncertainty, then the results clearly show an effect is all but certain.

5; 5-74; lines 26-27: "Overall, evaluation of the fish assessment endpoint suggests ecologically significant but low magnitude risk to fish in the Housatonic River from both tPCBs and PCB TEQ, based on a weight-of-evidence evaluation of multiple endpoints."

First, this statement is obtuse and confusing. Second, the statement ignores the facts that the data are not that complete, that the HQ's are exceeded, that the tissue levels in figures 5.4 are high compared to literature values. Rice, O'Keefe and Kubiak summarize the effects of PCB's and TEQ's on fish, observing that tissue levels of 5.6 ppm reduced growth in Atlantic salmon and 0.065 ppb in lake trout eggs caused 50% mortality. These do not take into account the exposures of multiple compounds that act together (Rice, O'Keefe and Kubiak, 2003), indeed even synergistically (Cook, Zabel and Peterson, 1997; Monosson, 1997).

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6; 6-9; lines 12-13: "Body weight is assumed to be a normally distributed parameter."

Is there evidence that body weight is in fact normally distributed? If so please cite, otherwise change the conditions of the assumption and estimate for different distributions

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6; 6-9; lines 21-22: “Therefore, only dietary items that comprise least 10% of total diet of each species were included in the exposure model. – “

So 4 items of 8% each will be ignored?

6; 6-10: Lines 21-23: “ …other techniques were used to derive the bounds on the mean (see Appendices G to K). Appendix C.5 describes the procedures for parameterizing prey concentration variables in more detail.”

The text needs to say more than simply refer to an appendix for an alteration of the standard method that is supposed to be applied throughout. Give some explanation here and more details in the appendix.

6; 6-24; lines 24 et seq.: “When data are lacking on the toxicity of a particular COC to the representative species or a reasonable surrogate, threshold ranges were developed. In these cases, it is not known whether the representative species is sensitive or tolerant. Therefore, a threshold range was developed that spanned the concentrations (or doses) that would be protective of sensitive species to those that would be protective only for tolerant species. The assumption is that the threshold for the representative species lies between these two extremes. To derive a threshold range, the toxicity literature was reviewed to determine the most sensitive and the most tolerant species for which studies have been conducted. Thresholds were derived for both the most sensitive and the most tolerant species using methods similar to those used in the pre-ERA (see Section 2.4 and Appendix B).”

This method assumes that there is NOT another more sensitive species that has not yet been tested – e.g. the most sensitive is already in the database.

7; 7-12; lines 2-3: “The exposure assessment for insectivorous birds focuses on both the PSA and several reference locations.”

Three sites were situated at various distances downstream of the GE facility within the PSA (Holmes Road, New Lenox Road, and Roaring Brook). Three reference locations (Threemile Pond, Southwest Branch, and Taconic Valley) were also included in the assessment.

The exposure assessment uses no sites in Connecticut, by admission. This application is unacceptable. The data indicate that the lower part of the river was also subjected to decades of PCB releases and that fish are carrying high PCB loads. The complete ignoring of Connecticut in this part of the assessment is unacceptable.

7; 7-22; lines 3-7: “Tree swallows are small birds with an average adult body weight of about 20 g. Body weight can be as low as 16.5 g when food availability is low, and as high as 25.5 g for females during the mating season (Robertson et

al. 1992). Newly hatched nestlings weigh about 1.5 g and achieve adult weight in about 14 days. Based on data cited in Dunning (1984), the mean body weight was estimated to be 20.1 g."

What is the distribution of body weights in tree swallows? Is it normally distributed around 20 g?

7; 7-25; lines 8-9: "Ratios approaching or greater than one indicate that the tPCB content was primarily due to maternal transfer, and not from feeding locally over the period from birth to 14 days.[1] … Footnote: [1] Ratios greater than one, observed at Southwest Branch in 1998, Threemile Pond in 1999 and 2000, and Taconic Valley in 2000, would seem to indicate depuration or growth dilution over the 14 days of growth. These ratios are associated with outliers among the pippers at each site, and should be considered indicative of very high proportions of maternal transfer relative to intake of local contaminants."

Notwithstanding the significance of maternal transfer over local feeding, the maternal transfer has to be considered caused by local contamination from females feeding the Housatonic watershed. Thus, the source is ultimately the PCB contamination of the river.

7; 7-; lines 12-13: "At these locations, the ratios ranged from -.61 at the Southwest Branch in 2000 to 1.89 at Threemile Pond in 2000."

What is the significance of these results?

7; 7-63; lines 20-25: "Table G.2-22… 44.9 to 80.2 mg/kg ww… from 7.5 to 14.4 mg/kg ww in pippers at the reference sites… at Roaring Brook had higher concentrations in 1999 than in 1998. Also, pippers from Southwest Branch had lower tPCB concentrations in 2000 than in 1998 and 1999 (Custer 2002)."
7; 7-64; lines 2-5: "1,390 ng/kg ww at Holmes Road to 2,890 ng/kg at Roaring Brook… Concentrations ranged from 562 to 730 ng/kg ww in pippers at the reference sites."

How do these compare with data from the literature?

7; 7-92; lines 3-17: The ERA summary

There is a problem here. The weight of evidence may well be bias by poor quality data in the evidence dataset.

So, how did the field study account for immigration of new birds from outside the area, for mortality of birds that fed on PCB contaminated food and died, and from the long term effects of PCB's on various biological processes? The field study did not account for any of these, and is not sufficiently convincing on its face.

8; 8-1; box: “in ovo?”

Did this analysis consider tPCBs and TEQs as ∑ risks? Or separate?

8; 8-8; lines 10 et seq.: *Transients and Great blue herons are mentioned, but the latter are not assessed. Is the reason for the absence of great blue herons that the eggs are not viable, the fish taste like an oily material and the population is not able to reproduce, as in mink? These are significant questions that need to be considered.*

8; 8-8; lines 22-23: “Therefore, effects to great blue heron productivity, or lack thereof, observed in the field would be difficult to attribute to specific COCs.”

It is not clear that the species should be ignored altogether.

8; 8-12; Lines 9-10: “The expose model for piscivorous birds focuses on the ingestion of tPCBS and 2,3,7,8-TCDD TEQ through the diet. Other exposure routes.”

Did the assessment consider eggs? See DiGuilio et al. 1999.

8; 8-17; lines 1, 6-9: “Nagy (1987) and Nagy et al. (1999) derived allometric equations for estimating the metabolic rate of free-living birds using the following general equation: FMR (kJ/day) = a x $BW(g)^b$ … (Eq. 2)… There were insufficient data to generate an allometric equation for Coraciiformes, of which belted kingfishers are members, so the equation for all birds was used. The slope term log a had a mean of 1.02 and a standard error of 0.0393 in log10 units, and the slope term b had a mean of 0.681 and a standard error of 0.0182 (Nagy et al. (1999).”

It is not clear that the equation for all birds is sufficient for this application. Did the investigators check the literature for closer values? If so, what were the results- even if nothing was found.

8; 8-19; lines 1-5: “Given these factors, it was assumed that fish would replace crayfish in the diet of kingfishers foraging in the areas around Woods Pond and Threemile Pond. Therefore, the percent contribution of fish in the diet was assumed to be 100%, and is not depicted in Figure 8.3-1. Ospreys prefer to forage in shallow waters in lakes and rivers where fish occur near the surface and may be easily seen (DeFraaf and Yamasaki 2001).”

Crayfish are supposed to be distribute din this river system and should provide food for other animals. If crayfish are absent, then this result may indicate unsuitability of habitat.

8; 8-34; lines 26-28: “This approach establishes a range of toxic effects thresholds for the most sensitive and tolerant avian species known and assumes that the thresholds for the representative species are within these bounds.”

Missing? Which species are?

8; 8-39; table 8.5-1: *In ovo seems to be completely lacking in these data!*

8; 8-47; lines 21-22: “It is assumed that the toxicity thresholds for the representative species lie within these ranges.”

What evidence supports this assumption? The EcoRA needs to make some adjustment and estimate for this assumption being wrong and that the thresholds are much lower for other effects over long-term exposures.

8; 8-48; lines 1-11: *Agree with these limits*.

8; 8-48; line 24: *Agree*

8; 8-48; line 30: “Therefore, kingfishers are considered to be at low risk in the PSA as a result of exposure to tPCBs and TEQ.”

There are not data to show this. The kingfisher study was failed on account of lost nests. These results cannot be used in the evaluation. Therefore, the literature and other data must be used to make the decisions in this case.

8; 8-49; lines 9-10: “Ospreys are therefore considered to be at risk in the PSA as a result of exposure to tPCBs and TEQ”

We agree with this conclusion and that osprey are also at risk in the lower reaches.

Top paragraph in the box:
Agree

Bottom paragraph in the box: *Disagree. The belted kingfisher study was insufficient.*

9; 9-8; lines 11-15:
What other species?

9, 9-16: 11-14
9; 9-17; lines 3-6: – “However, a nursing female food intake rate was not considered in this assessment because nursing is a short-term event relative to the extended time scale of this assessment (1year). The time scale of this exposure assessment was chosen to be approximately 1 year based on the extended reproductive cycle of mink (mating starts in early March)”

This is a real problem. The metabolic costs of reproductive cycles in mink are substantial and make the females more susceptible to a variety of conditions during late stages of pregnancy and then lactation. The literature on mink, and the information on mink as test animals indicates that there are important differences that can and co affect toxicological outcomes. The EcoRA at least needs to assess the results with and without the adjustment for metabolic costs of reproduction in females.

9; 9-17; line 10: the equation for FIR is applied to mink

I doubt this method works for mink and mustelidae.

9; 9-36; lines 14-16: “However, given the close similarities between mink and otter in their feeding preferences and phylogeny, an assumption was made that toxicity data for mink can be used to approximate toxicity to river otter.”

This is probably OK, but there is nothing in the EcoRA that anyone conducted a thorough literature investigation.

9; 9-44; lines 20-22: “The results also confirm that only a small amount of fish (< 0.5%) from the Housatonic River would be required in the diets of mink to activate Ah receptor pathways and processes in mink (Tillitt et al. 2003).”

This observation is consistent with the literature and the investigation of Tillet et al submitted as part of this EcoRA documentation.

9; 9-75; lines 7-10: “The Monte Carlo sensitivity analyses indicated that the free metabolic rate (FMR) slope and power terms were generally the most influential variables on predicted total daily intakes of COCs. However, no measurements of free metabolic rate were available for the representative wildlife species.”

This is a big problem here and elsewhere. The most significant determinant of the risk estimate has no direct measurements, by admission. One way to address the problem is not simply with a Monte Carlo, but with upper and lower bounding estimates to expand the range of risk estimates.

9; 9-75; lines 26-27: “The uncertainty due to lack of knowledge on diet of mink in the PSA was partially addressed by using distributions to represent variability in diets observed at other similar sites”

This is an acceptable, though not ideal approach to the problem. Please state what sites were used for the determination of diet- were sites in upper Housatonic, or on the Connecticut River, or nearby, but not on the Hudson, which is also PCB contaminated.

9; 9-79; lines 20-22: "The dose-response curve for effects of tPCBs to piscivorous mammals indicated that 10% and 20% declines in fecundity would be expected at doses of 0.0128 and 0.0272 mg/kg bw/d, respectively"

And what might this decline in fecundity mean to the population? Was this the only effect on reproduction?

9; 9-79; lines 25-27: "This means that mink and river otter feeding in the PSA receive tPCB doses that cause adverse reproductive effects. A similar conclusion was reached for TEQ."

Our review of the literature and the results of the investigations are in agreement with the EcoRA on this point – mink and otter populations are adversely affected by PCB's and other COC's.

10; 10-42; line 12: "Other carnivorous mammals observed in the PSA included bobcats, fishers, and long-tailed weasels."

Ecological surveys from Woodlot indicate large populations of black bears and coyotes as well; these should be included in the study.

10; 10-64; lines 22-26: "In contrast to the findings in the Boonstra (2002) study, the results of the supplemental analyses conducted for this ERA indicated a significant relationship between tPCB spatially weighted and measured concentration in soil and survival of shrews from summer to autumn for males, females and males and females combined. Although the confidence limits indicate that the relationships are not strong. Some of the "noise" in the relationships may be attributed to factors listed above."

Our review of the Boonstra investigation and the present analysis is in agreement with the EcoRA conclusions that the populations are affected by PCB's in the Housatonic watershed.

10; 10-65; lines 23-27:

I agree

11; 11-1; top of page: Partial list of T/E species

What is the full list of T/E species?

11; 11-17; figure 11.2-2&3: *Why so large? Not realistic!*

11; 11-34; line 3: “ng/kg bw/d & mg/kg”

What are the correct units here?

11; 11-39; lines 8-14: “Several researchers estimated NOAEL and LOAEL values for TEQ for bald eagles (Giesy et al. 1995, Bowerman et al. 1995, Elliot et al. 1996). Giesy et al. (1995) and Bowerman et al. (1995) sampled the impact of contaminated prey fish on bald eagles in the Great Lakes region and derived a NOAEL for bald eagle eggs of 7 ng/kg TEQ. This value is based on toxicity studies conducted using other avian species, including the chicken, wood duck, and American kestrel. The bald eagle is less sensitive to TEQ compared to the chicken, ducks, and other gallinaceous species,; therefore, this value may be low”

This section makes no sense as written. Also, further mention and/or study needs to be made of domestic animal populations in both Ma. And Conn.

11; 11-42; lines 1-9: TEQ to Bald Eagle.
This conclusion of the NOAEL is odd given that Geisy estimated a NOAEL of 7 ng/kg shown in the above paragraph. The EcoRA needs to use the lower value.

11; 11-42; lines 19-20: For this assessment, a NOAEL of 4.9 mg/kg PCBs in eggs was selected for American bitterns.

Why was this NOAEL selected? A lower value would be more protective, and given the uncertainty, a better choice.

11; 11-61; lines 9-13: “The results from the modeled exposure and effects line of evidence indicate that there is no evidence of harm to adult bald eagles exposed to TEQ in the PSA, but high risk to bald eagle eggs. There is, however, evidence of harm to bald eagles and American bitterns exposed to tPCBs and an undetermined risk for American bittern exposed to TEQ and small-footed myotis exposed to tPCBs and TEQ in the PSA.”

It is not clear why this is indetermined. Surely some estimate can be made.

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Appendix:

Story by Tuz sept 24 2003.
Articles on flooding and flood plain
Sediment data on excel file
Literature search

September 30, 2003
Questions submitted by Dr. P.L. deFur, on behalf of HRI for the reviewer panel on the Ecological Risk Assessment of the Housatonic River:

1. EPA has maintained that a species is unaffected if the population can sustain itself, even if the individual members of the population suffer from abnormalities. Does the review panel agree that a population of sick animals is acceptable or normal?
2. The EcoRA uses literature equations for estimating FMR (or SMR) on which the equations for toxicity and risk estimates depend. What error is introduced by this procedure and is there an alternate procedure that is better?
3. How can EPA best minimize of understand the consequences of having no direct measurements of field metabolic rate (FMR), or of SMR for that matter?
4. Do the assumptions and procedures appropriately account for the unknowns and uncertainties in the toxicology and life history information of the species and of the ecosystem as a whole?
5. Are the limited sediment data in Connecticut sufficient to definitively conclude that risks to wildlife and aquatic life are low?
6. What are the correct or best NOAEL's to use for bald eagles? See chapter 11, 11-42: lines 1-9.
7. Several reviews summarize the effects of PCB's in combination with dioxins, pesticides, other contaminants (Rolland et al., 1999; Geisy, 1997; DiGuillio et al., 1999) but this EcoRA does not consider multiple chemicals, except for Ah active chemicals. How should EPA deal with multiple chemicals in this EcoRA?
8. This EcoRA seems to not use egg concentrations to estimate effects on birds. Is this the correct method, or should EPA adjust the EcoRA and use egg levels of PCB's and TEQ to estimate effects?

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Sept24 03 floods

Subject: Fast-moving rains cause flash flooding and town dispute
Date: Wed, 24 Sep 2003 09:26:32 -0400
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The News-Times

LOCAL

2003-09-24

Fast-moving rains cause flash flooding and town dispute

By Susan Tuz
THE NEWS-TIMES

A cold front moving through the area Tuesday morning brought rains that came with such force they washed out roads and flooded basements in several local towns.

Highway crews were out well into Tuesday night repairing damage in New Fairfield, New Milford and Patterson, N.Y. Local flooding was also reported in Danbury from the storm, which brought reports of two tornadoes in upstate New York and knocked out power to thousands there, including 2,400 near Brewster.

For a short time, officials said, the rain came down at a rate of 2.94 inches an hour.

In one neighborhood on the border between New Fairfield and Patterson, N.Y., resident Ed Gerrity worked to divert flooding from a neighbor's basement and refill washed out roadsides with gravel.

Ed Gerrity
Water rages down Fulton Drive on the New Fairfield-Patterson, N.Y., line Tuesday morning. Neighbors' basements were flooded, lawns were washed out and gullies were created along the road.

The News-Times/Wendy Carlson

A makeshift dam made from a sofa diverts water away from a home.

"He's like the Good Samaritan," said Christie Gotto of her neighbor Tuesday afternoon. "Right now, he's out there clearing debris off our yard. He helped save the wheelchair ramp our son, Ryan, uses so Ryan will be able to get off the bus when it brings him home. He's just an angel sent from Heaven."

Gotto's son, age 6, has cerebral palsy and attends classes at Blichdale Children's Hospital in the Brewster school district. The Gottos pay taxes to the town of Patterson. But when Gotto's husband, John, called that town for help with the storm damage, he was left high but far from dry.

"Fortunately we had a pump going in the basement (that Gerrity loaned them), and Ed helped me move the couch out of the family room to the roadside, where we created a dam to divert water back down the road," John Gotto said. "We just moved here in July, and I'm used to calling our town and having them take care of things right away."

The News-Times/Wendy Carlson

Mike Melnick cleans up around his house following the storms on Tuesday. Melnick, who lives in Putnam Lake, N.Y., wrapped his house in plastic to prevent flooding but to no avail.

Gotto said Patterson's Highway Department did send out a truck, but when it arrived, the crew told him the portion of the road where the problem originated was in New Fairfield and repairs and cleanup were not Patterson's responsibility.

Patterson's director of public works could not be reached for comment Tuesday. He was out late with his road crews working on storm damage. So Gerrity worked through the morning with a crew of three laborers he hired himself. They moved rocks and tree limbs and filled in gullies to make Fulton Drive passable.

"It's always a battle between the towns when something happens here," Gerrity said. "I've gotten so I just do things for myself."

Bobby Rzasa , director of public works for New Fairfield, said it is possible the water flow on Fulton came from the portion of that road that lies in New Fairfield, but it would be hard for him to say without going out there. Rzasa said New Fairfield's road crew had been out all day racing to keep up with the damage. He was back in the office briefly at 3 p.m. but would be back out on the road with his crew soon, he said.

In New Milford, roads in the Gaylordsville section of town washed out when railroad culverts blocked up, Public Works Director Pat Hackett said.

"By Front of the Mountain Road, the culvert blocked and when it blew out, it took part of the railbed with it," Hackett said. "And on River Road, railroad culverts also blocked up, causing gravel to wash down into the yards of houses."

Seven roads in the northwestern section of town were particularly hard hit, including Hine Road, Indian Trail, Long Mountain Road and Stilson Hill Road.

Hackett said the roads would be passable by Tuesday night. But they won't be back in good condition until the end of today, he said.

The rain also hit Danbury harder than officials expected, in part because the city's reservoirs, ponds and rivers are already pretty full.

"There's no place for the water to go right now," said Public Works Director Bill Buckley. "Look at Lake Kenosia, it's full. Look at the Margerie Reservoir, it's full. The Still River is running high. The swamps are high."

Don Peterson has lived for six years at 58 Greenlawn Drive in Jensen's Trailer Park, so on Tuesday he watched the water rise without surprise. The trailer park is near the swamps that surround the Danbury Fair mall and Lake Kenosia.

"Sometimes it's scary," Peterson said. "It came into the house in 1999 during Hurricane Floyd."

On Tuesday, the water filled the road in front of his house, and buried his front and side lawns. For a time, his home sat on a spit of land in a temporary lake.

"It will be gone in 12 or 14 hours, maybe less," Peterson said. "It all depends, but this happens five or six times a year."

Ridgefield, Brookfield and Newtown reported little damage from the storm. In Bethel, highway department superintendent Robert Dibble said there were few problems even though he measured 1.1 inches of rain at the public works garage on Tuesday morning.

News-Times staff writers Heather Barr, Marietta Homayonpour, Joe Gould and Mark Langlois contributed to this report.

http://www.newstimes.com/cgi-bin/dbs.cgi?db=news&view_records=1&id=55105&Print_Story=1&ssi=1

Review of USEPA report 99-1010
"Exposure and effects of chemical contaminants on tree swallows nesting along the Housatonic River, Berkshire Co., Massachusetts, 1998-2000"

This study determined the exposure of tree swallows (*Tachycineta bicolor*) to PCBs and other chemicals in the Hoosatonic River Valley, and whether hatching success was related to chemical exposure. Previous studies only monitored the nest success of eight passerine species in 1993 within and outside the 10-year floodplain of the Hoosatonic River, and found no difference in clutch size, hatching rate, or fledgling success between birds nesting within and outside the floodplain. Sample size for that study was low, no data on PCB concentrations was collected, and only one of the species studied was an aquatic insectivore. Tree swallows have been found to be a much better indicator of local sediment contamination, since they primarily feed on emergent aquatic insects near their nests, and these residues in their tissues reflect local sediment contamination for those chemicals that transfer into the insect biota. Additionally, tree swallows make good study subjects since they nest densely in nest boxes, allowing researchers to establish specific study sites of interest. Data on tree swallow exposure exists for comparison with other studies throughout the U.S. and Canada, and a 1981 study along the Hudson River in New York suggested effects on reproduction rates due to heavy PCB contamination.

This study found that average concentrations of total PCBs (means ranged from 31.5 to 100.9 µg/g wet wt) in tree swallow eggs from along the Hoosatonic River, Maasachusetts were the highest reported anywhere for tree swallows and even for most piscivorous birds. Substantial local exposure at the mainstem Hoosatonic River sites was

indicated by accumulation rates between 30 and 75 µg/day total PCBs. This result was corroborated by concentrations of total PCBs in food items taken from the stomachs of nestlings, which varied between 2 and 19 µg/g wet wt. total PCBs. These results supported the conclusion that PCB and dioxin/furan contamination in tree swallow tissues originated from contaminated sediments in the Hoosatonic River. Total PBBs, along with total dioxin and furans, were negatively correlated with hatching success in 1998 and 1999. The correlation was statistically significant, but weak.

I found this study to be comprehensive and thorough, with appropriate attention given to previous studies, both those of similar focus as well as those for this particular area of the Hoosatonic River in Massachussetts. The experimental design was clear and consistent, and could easily be retrofitted for a cleanup assessment study. The nature and extent of PCB contamination was investigated only as it pertained to tree swallow hatching success, and could be broadened in future studies, with a larger study area encompassed and greater sample size analyzed.